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ELISHA MITCHELL, D. D.

BY EX-PRESIDENT KEMP P. BATTLE, LL. D.,
The last survivor of the Faculty of June, 1857

Elisha Mitchell was born in Washington, Litchfield County, Connecticut, August 19th, 1793. His father was a respected farmer, content to live a farmer's life. His mother, Phoebe Eliot, was a descendant of Rev. John Eliot, the "Apostle to the Indians," a learned man, who translated the Bible into the language of the Indians of Massachusetts. Her grandfather was also eminent as a divine and a scientist,—Rev. Jared Eliot, M. D., and D. D. who was honored by the Royal Society of London with a gold medal for a discovery in the manufacture of iron.

Young Mitchell showed from boyhood the talents of the Eliot family. He graduated in Yale University, then College, with high honor in 1813, along with President Longstreet, the author of Georgia Scenes, Dr. Denison Olmstead, author and professor at the University of North Carolina and Yale, and Thomas P. Devereux, Reporter of the Supreme Court of North Carolina. Senator George E. Badger was a classmate but left before graduation.

After graduation he taught in a school for boys at Jamaica, Long Island. In the spring of 1815 he took charge of a school for girls in New London, where he married Maria S.—the Daughter of Dr. Erasmus North, a physician of the City. In the next year on the recommendation of the Chaplain of the Senate, Rev. Sereno E. Dwight, through an active Trustee of this institution, Wm. Gaston, a representative in Congress, he was elect-

ed Professor of Mathematics and Natural Philosophy in this University in place of Dr. Caldwell, made President a second time after the resignation of Dr. Robert H. Chapman. Professor Mitchell reported for duty January 31st, 1818.

He applied himself to his duties with great diligence. To him is the honor of introducing into the curriculum the study of Differential and Integral Calculus, then called Fluxions. His favorite study however was Nature, and in 1825, on the departure of Professor Olmstead to Yale, he was at his own request transferred to the Chair of Chemistry, Geology and Mineralogy, Mr. James Phillips taking his former chair. Botany was also under his charge.

It was at this time that the General Assembly made a small appropriation for a Geologic Survey of the State. For about six months Olmstead was director and then Mitchell succeeded. Each published a short preliminary Report. The appropriation was not renewed.

In 1835 Professor Mitchell made tours through the counties of Johnston, Wayne, Onslow, Craven and Beaufort, and then through Alamance, Guilford, and the counties west, as far as Buncombe, for the study of the Geology, Mineralogy and Botany of the State. He embodied is observations in closely written letters to his wife. These were shortly before her death given to the University by his unmarried daughter Margaret, and were published as one of the James Sprunt Historical Monographs, with annotations by Dr. Battle, the Professor of History. He made subsequent tours in our mountain counties in 1838, 1844 and 1856, discovering in 1844 the highest peak east of the Rocky Mountains, now called in his honor Mount Mitchell.

After the death of President Caldwell in January of this year he was Chairman of the Faculty for a year, until the arrival of President Swain in January 1836, and was an efficient executive officer.

While Dr. Mitchell lived in Connecticut he was a member of the Congregational Church. After his removal to Chapel Hill he joined that of the Presbyterian and was ordained to the

Christian Ministry in 1821. For many years he preached in the University Chapel every alternate Sunday, and often at night in the Union, or Village, Chapel, which in 1848 gave place to the Presbyterian Church edifice.

As a preacher I cannot say that he was eloquent, or inspiring. His manner of delivery was tame and awkward. His eyes were fixed on his manuscript and he never raised his voice, but his sermons were always sound and sensible. He did not follow the old school in claiming that every word of the Holy Scriptures was inspired by God, but thought that mistakes in merely historical matters had occurred by errors of copyists or otherwise.

I recall only one sentence of his sermons. The subject was "Moral Courage" and was ably handled. He began "The man who is on a sidewalk and sees an angry bull approaching with horns lowered ready to gore him, and does not jump over the fence, he is not a brave man, he is a fool." Then he showed the nature of true courage.

For years he was Bursar of the University, in charge of the collecting of tuition fees and other sums and attending to the repair of College Buildings and similar work. The substantial stone walls around the campus were built under his direction. He was also a Justice of the Peace and acting Mayor, building and repairing streets, roads and culverts.

As he grew older, he studied in a room in the South Building to a late hour, and was much relied on in the suppression of disorders. Although he was vigilant in the performance of this duty, the Professors and Tutors in his day being expected to act as police-officers, he always was on the side of leniency in punishment.

As a teacher, in the studies under his charge, and in the Old Testament taught to the Junior classes Sunday afternoons, he was inspiring and interesting. He did not confine his attention to the text-books but often gave facts and incidents gathered from his reading and experience. He did not require laboratory work of his classes, but often performed experiments himself in presence of the class. He indulged occasionally in

humorous anecdotes, which the College critics alleged were handed down from class to class. For instruction in the Geology of North Carolina he published a thin Octavo with that title embodying his researches. He prepared a treatise on Chemistry. He printed a few pages in pamphlet on Botany, and "Statistics, Facts and Dates."

If Dr. Mitchell had used his great brain and uncommonly sound health and strength of body in the study and development of one branch of science he would have been world-famous. But his eager curiosity urged him to more or less partial dipping into many subjects. He read voluminous theological works. He devoured Blackstone and other legal literature in order to qualify himself for the office of Justice of the Peace. He learned the use of theodolites and other instruments, and was a skillful engineer. He was theoretically versed in Astronomy, and Political Economy, Agriculture, Horticulture, Mining.

He was learned in Higher Mathematics. He was a vast reader of the history, poetry, political problems, philosophy, in truth of the several literatures of ancient and modern times. The learned and unlearned of the University and of the village called him with undoubting faith "a walking Encyclopedia." And it was a laudable peculiarity of his that he was always willing to impart information to any questioner however humble. Another peculiarity was entire self-reliance. He formed and executed his plans without consultation with any one. Sometimes those plans failed, as when, for instance he undertook to change the front of the University to the South, running the Raleigh road through the Southern part of the campus, and building a useless massive porch on the same side of Gerrard Hall. He was never heard to explain or excuse the project. He was employed to build two miles of the Raleigh road ascending the Chapel Hill promontory on the South of the Piney Prospect Hill, and when Professor afterwards Bishop Green, being made Road-overseer improved the road by a more easy ascent, the good doctor took it as a personal insult, and never forgave him. Shortly before his death, without consultation with any one he began the construction of a rock wall

into University lands, leaving the Trustees, Faculty and the public to guess at his motives. The favorite conjecture was that he designed a Botanical Garden, but there was no authority for the guess.

Let me not be understood to imply that his labors were often in vain. As Bursar, besides receiving and disbursing University moneys, he had charge of the University grounds and buildings. His success is still evident in the picturesque rock walls around the campus, the roads he built and other improvements.

Dr. Mitchell published no great book but he was active with his pen. I have heretofore mentioned his Geology of North Carolina, his Chemistry, his notes on Botany, and Facts and Dates. Without attempting minute descriptions I give a list of his contributions to journals and newspapers and of his pamphlets, not heretofore mentioned.

1. Contributions on scientific subjects to Silliman's and other journals. I suggest that some student search for these and describe them.

2. Pamphlet in defence of Presbyterian tenets, in answer to Bishop Ravenscroft, the first Bishop of North Carolina.

3. Pamphlet, proving that Slavery is righteous according to Holy Scripture and sound reason.

After publishing this Dr. Mitchell revisited his birth-town and was mortified that the authorities of his Church refused to invite him to occupy its pulpit.

4. A series of letters in the Raleigh Register attacking the Report of Dr. Ebenezer Emmons on the Deep river deposits of coal. Dr. Emmons claimed that there was a valuable coal basin. Dr. Mitchell contended that the indications were only of a four feet seam, with inclinations of about 18 degrees to the surface of the earth, and that there was no evidence of a diminution of this incline. Actual working sustains Dr. Mitchell.

5. Address before the North Carolina Agricultural Society at the Fair in 1856, in which he gave much valuable information on Agricultural Chemistry.

6. Letters to the Raleigh Register in reply to General

Thomas L. Clingman, who claimed that Dr. Mitchell was never on the highest peak of the Black Mountains, but that he Clingman was the true discoverer. He caused W. D. Cooke to designate on his wall-map the highest peak as Mt. Clingman. On the death of the Doctor he gracefully surrendered his claim. It is now conceded that Dr. Mitchell was right. He is confirmed by the United States Geologic Survey of 1881-'2, the highest and final authority.

The claim of General Clingman, on account of the lapse of time since Dr. Mitchell ascended the High Peak, his ability as a controversalist, and his influence as Senator with the departments at Washington, threatened to be formidable. Dr. Mitchell determined in June 1857, to revisit the mountain, to make instrumental measurements of its highest peak and to obtain the evidence of those who had accompanied him when he made his first ascent. With charasteristic self-reliance on the 27th of June, he left his party at the Patton House on the Southern flank of the mountains intending to journey to the top, and then go down to the settlement on Caney river in order to interview Big Tom Wilson and others, who knew about his former visits. A heavy rain detained him on the Peak and alone and in darkness the brave but rash old man attempted to descend the slippery banks of the Cat-tail fork of Caney river, along which there was no path, through thick laurels and over steep and slippery rocks. In attempting to pass around a waterfall, he slipped down a cliff forty-five feet and then fell over a precipice fifteen feet into the pool below. His watch was stopped at nineteen minutes past eight on the 27th of June, 1857. The body was found after a lengthened search 8th July, mainly by the woodcraft of Big Tom Wilson. Zebulon B. Vance, afterwards Governor and Senator, was one of the most active of the searching party. The body was not bruised and it was evident that being stunned by the fall he died painlessly by drowning.

At the request of the family he was buried in Asheville on the 10th of July, a touching sermon being preached by Rev. Robert Hett Chapman, D. D., a son of the second President of the University of the same name.

On the 14th June, 1858, at the request of many of his friends the body was exhumed and reburied on the highest peak of the Black Mountains on the 16th of the same month. A sermon was delivered by the Episcopal Bishop of Tennessee, a graduate and Tutor of the University in 1820-'21, Rev. James Hervey Otey, D. D. After him President D. L. Swain made a "Vindication of the propriety of giving the name of Mitchell to the Peak." Both sermon and address were repeated in Asheville two days afterwards.

For years the grave was marked by a cairn of stones gathered in its neighborhood. The title of the acre of land around it was vested in the University of North Carolina. On August 18, 1888 by means of a bequest of the youngest daughter of Dr. Mitchell, Mrs. Eliza North, widow of Richard S. Grant, supplemented by minor donations, the present monument of white bronze was erected on the summit. It is universally regretted that within a few weeks this monument was blown down and ruined by a tornado.

The trail to the summit, including ten miles, was in such condition that it required the labor of fourteen men thirty nine days to make it passable. The sections of the monument were transported on men's shoulders, the whole weighing about nine hundred pounds. The base is formed of two blocks of gneiss bedded together with Portland cement. The work was accomplished at the request of the University Faculty by the unparallelled energy and labor of Dr. Wm. B. Phillips, once Professor of Mining an dMetallurgy in the University of North Carolina, now Professor of Geology in the University of Texas.

I have given my opinion of Dr. Mitchell as a preacher and teacher. As a man, in social life and as a citizen, he had conspicuous virtues. He was charitable in deed and in speech. He seldom spoke harshly of anyone, even under provocation. His advice and his purse were open to the humblest. His acts of charity, very frequent, were known only from the recipients. In his controversies, he refrained from angry words and attacking motives. Notwithstanding his superiority in learning there was no ostentation. Although he preferred to be alone

with his books, his pen, or his thoughts, when in company he was agreeable and jovial—some of his jokes, according to the fashion of his youth, more coarse than suits modern taste. He was eminently kind to his family and slaves, often teaching his children, so that they were unusually well grounded in literature and science. On the whole he was looked up to and beloved by all who met him, whether casually or intimately. No one who shook his hand but thought *a great man!* In the world centers of science and scholarship he would have been among the greatest.

CHAPEL HILL, N. C.

THE COGGINS (APPALACHIAN) GOLD MINE*

BY JOSEPH HYDE PRATT

The Coggins Mine is located in the northeastern part of Montgomery County, North Carolina, 1½ miles north of Eldorado, the nearest postoffice, and 12 miles northeast of Troy, the county-seat. The nearest railroad point is Whitney, on a branch of the Southern Railway, running from Salisbury to Norwood, a distance of about 7 miles nearly west.

A description of this mine will indicate or give the salient features of several other mines in this general district.

GEOLOGY

The country rocks of this area are composed of argillaceous slates or schists, which have probably been derived from land detritus or waste, and varying amounts of tuffaceous material. Cutting these rocks at sharp angles to their schistosity are diabase dikes, which vary from a few to 6 feet in width. The strike of the schistosity of the slates is approximately N. 42° E., and they are dipping from 75° to 80° northwest. The slates are both soft and silicified and carry quartz lenses or stringers from very small narrow ones to some that are 10 or more feet in width. These slates have very evidently been faulted, and the resulting fault line has followed pretty much the schistosity of the slates; but in some instances it has cut across this at a very sharp angle. The result of this faulting has been the formation of quartz veins referred to, and also to a general silicification of the slates. The width of the slates which have been subjected to this mineralization and silicification varies up to as much as 50 to 60 feet. Another result of the mineralization has been the introduction of considerable gold-bearing pyrite into the hands of schists or slate. Some of this pyrite occurs in minute cubes up to one-eighth of an inch in diameter. There is a decided difference in the origin of the free gold in the quartz seams or slates and that which occurs in the gold-bearing pyrite. I believe it will be found that considerable of the gold in the pyrite occurs

* Reprinted from Economic Paper No. 34, of the North Carolina Geological and Economic Survey, pp. 49-59.

as free gold, and not in chemical combination with the iron sulphide or as a gold sulphide. Specimens were found in which free gold occurred in perfectly fresh pyrite. The gold runs out into very minute cracks in the pyrite, so that it is impossible to crush the ore fine enough to liberate all this gold without causing slimes. For this reason all the free gold cannot be saved by amalgamation.

The veins have a lenticular structure, as observed in horizontal and vertical planes, varying very widely in width, both along the strike and dip, and are separated by bands of schists or slates from other similar quartz veins. The ore body of this band of mineralized slate can readily be divided into two types: one consisting of numerous very narrow stringers of quartz, lying along the planes of schistosity of the rock, and which are separated from each other by narrow bands of slate which contain more or less pyrite, but which are not very silicified; and the other type containing larger masses of quartz occurring in veins or seams, and the slates inclosing them are silicified to a much greater extent.

There is great variation in the values carried by these ore deposits, and there seem to be well-defined ore shoots which also have a lenticular structure and which are richer than the balance of the vein. In some instances the foot and hanging walls are well defined, but in many cases the walls of the vein could only be determined by assaying the ore to determine to what extent the vein could be profitably worked. To one who is unfamiliar with this formation it is often very difficult to distinguish between the rich and lean portions of the vein. It is absolutely necessary in working this type of deposit to constantly sample the ore to determine its value, and the position of the vein for ore seams.

Diabase dikes have been observed cutting the schists and ore deposits, but they have been intruded subsequent to the formation of the ore, and it must have faulted or displaced the ore deposits but very little.

Three diabase dikes have been observed, two of which were exposed in the underground workings and the third at the extreme end of the "mine tract" in an open pit.

MINERALOGICAL CHARACTER OF THE ORE

The ore consists principally of free gold, with some pyrite and a gangue of white quartz or silicified slate, or both. The pyrite seems to be more or less disseminated through the schists and carries some gold, which it is believed is largely in the free state. The seams of slate that occur in the vein are also impregnated with small particles and crystals of pyrite, although their gold content is often very low. These barren portions vary in width from a few inches to several feet.

A small amount of calcite has been observed in the quartz seams, and a very small amount of arsenopyrite.

The veins are altered usually to a depth of 50 to 70 feet, but in some instances they are partly altered to a still greater depth.

VEINS.—There are two so-called veins that have been developed: one known as the "East Vein" and the other known as the "West Vein"; but as far as can be determined, these two are parts of one general ore formation and do not represent two distinct depositions of ore. The two bands of slate impregnated with the quartz veins and seams were supposed to be separated by a band of barren slate, but it was found upon sampling this that it carried a certain amount of gold.

DEVELOPMENT WORK.—The property has been developed principally by one shaft, with its drifts and cross-cuts. A certain amount of prospecting has been done at other points along the strike of the slates. At the southwest end of the property in a line S. 42° W. from the shaft, a pit (A) about 8 feet deep was sunk along the edge of a diabase dike. At several points between this pit and the shaft, several crosscuts were made, exposing the slates, but it did not show any mineral of value. To the northeast of the shaft, several pits have been made, the principal one being about 400 feet from the shaft, where a pit (B) was sunk 12 or 15 feet, that exposed the slates. This pit was approximately N. 42° E. from the shaft.

The main shaft was sunk vertically for a distance of about 8 feet, and then was turned, following approximately the dip of the slates; and is continued on this incline to the lowest level,

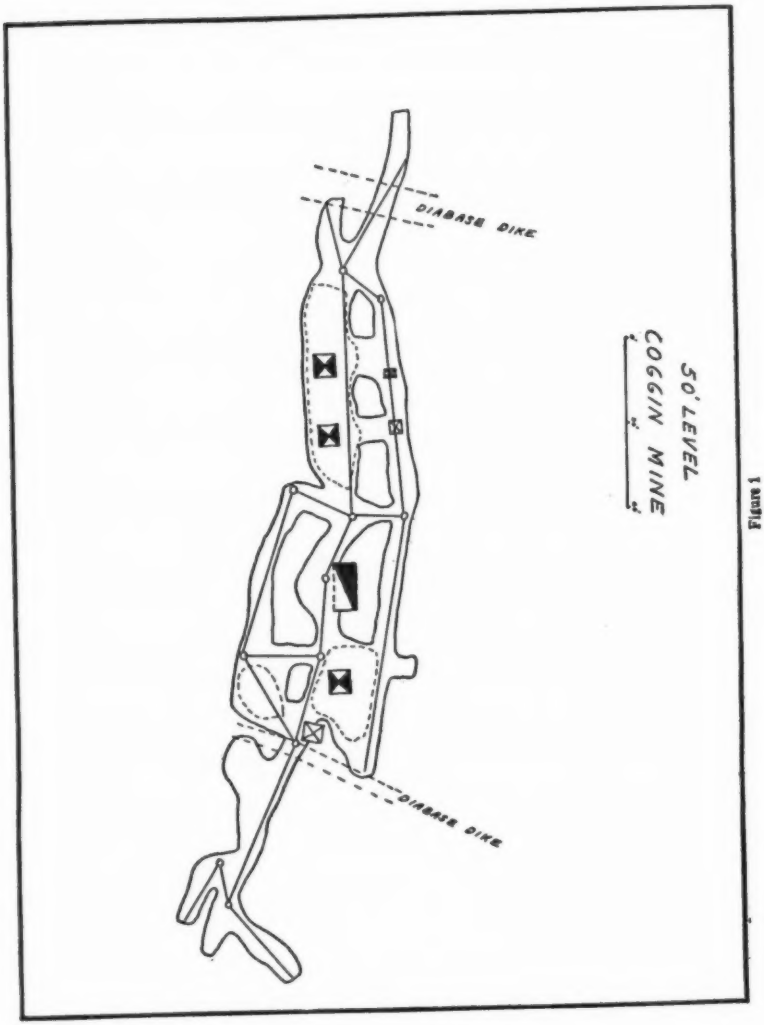


Figure 1

approximately 260 feet. Four levels have been developed from the shaft: one known as the "50-foot Level," which is approximately 57 feet from the collar of the shaft. Another level known as the "100-foot Level," a third known as the "200-foot Level," and a fourth known as "250-foot Level."

50-foot Level.—On the 50-foot level development work has been extended for a distance of 142 feet to the southwest of the shaft and 172 feet to the northeast of the shaft. At a point 60 feet southwest of the shaft, a diabase dike was encountered; and 130 feet northwest of the shaft another diabase dike was encountered. (Fig. 1, p. 168.) Most of the work on the 50-foot level has been stoping of ore that existed between these two dikes; and the ore has been taken out very largely from this level to the 100-foot level, also to a considerable extent from this level toward the surface. (Fig. 2, p. 171.) Blocks and pillars of ore have been left, some of which carry good values, but have not been reckoned as a part of the ore in sight. There seem to be two veins of ore, separated by a block of slate that carries considerably less value than the veins; but, as tested in certain places, carry pay values. At the extreme northeast of the drift of this 50-foot level the slates were tested, which show no free gold; and this indicates that beyond the diabase dike on the northeast there is but little ore, unless it should be found that the ore-bearing portion of this slate has been faulted. To the southwest of the southwest dike ore was encountered and stoped for a distance of about 30 to 40 feet. The extreme southwest end of the drift was tested, which showed a certain amount of free gold; indication that the ore body was continuous in this direction. The 50-foot level is connected with the surface by an upraise of 50 feet to the southwest of the shaft, and with another of 60 feet to the northeast. It is also connected with the 100-foot level by a winze from the stope to the southwest and a stope to the northeast of the shaft. (See plan of level, Fig. 2, p. 171.)

100-foot Level.—On the 100-foot level development work has been extended for a distance of 60 feet to the southwest of the shaft and 102 feet to the northeast. Besides the stoping that

was done from this level toward the 50-foot level, considerable underhand stoping has been done to the northeast of the shaft; and a winze has been sunk from this stope to the 200-foot level. The ore as exposed on this level was very carefully sampled, so that a comprehensive idea can be obtained of the occurrence of the ore bodies. There seems to be two ore shoots to the northeast of the shaft, separated from each other by a band of slate, which, however, is gold-bearing, as indicated by the two samples assayed, which showed $2.11 and $2.51 value in gold. The southwest ore body has been developed by a drift and cross-cut, and the ore as exposed was carefully sampled. This gave a value of approximately $9 per ton, for a width of approximately 20 feet. The work to the southwest of the shaft is apparently in the barren or partially barren band of slates, separating the two ore shoots, which accounts for the low values obtained from the assaying of the slates in the vicinity of the shaft. The southwest stope of this 100-foot level, which comes within 12 feet of this level, encountered on the southwest the diabase dike, which accounts for the stoping being stopped in that direction. The cross-cut was extended to the southwest from the winze connecting this stope with the 100-foot level for a distance of 45 feet; and then another drift was extended for about 30 feet to the southwest, cutting through the diabase dike. A sample was taken of the supposed ore just beyond the dike, but this showed but very little value. (See plan of level, Fig. 3, p. 172.)

200-foot Level.—On the 200-foot level development work has been extended for a distance of 90 feet to the southwest and 120 feet to the northeast, and the ores have been stoped at two points: one at the extreme southwestern portion of the level and the other about 20 feet from the extreme northeastern portion of the level. Both overhead and underhand stoping have been done. Neither of these stopes connect with the 100-foot level; but a connection with the 100-foot level is had by the winze sunk from the northeast stope of the 100-foot level to a cross-cut on the 200-foot level, which is to the southeast of the stope. The development work on this 200-foot level indicates that the so-called "two-ore bodies" of the 50- and 100-foot levels

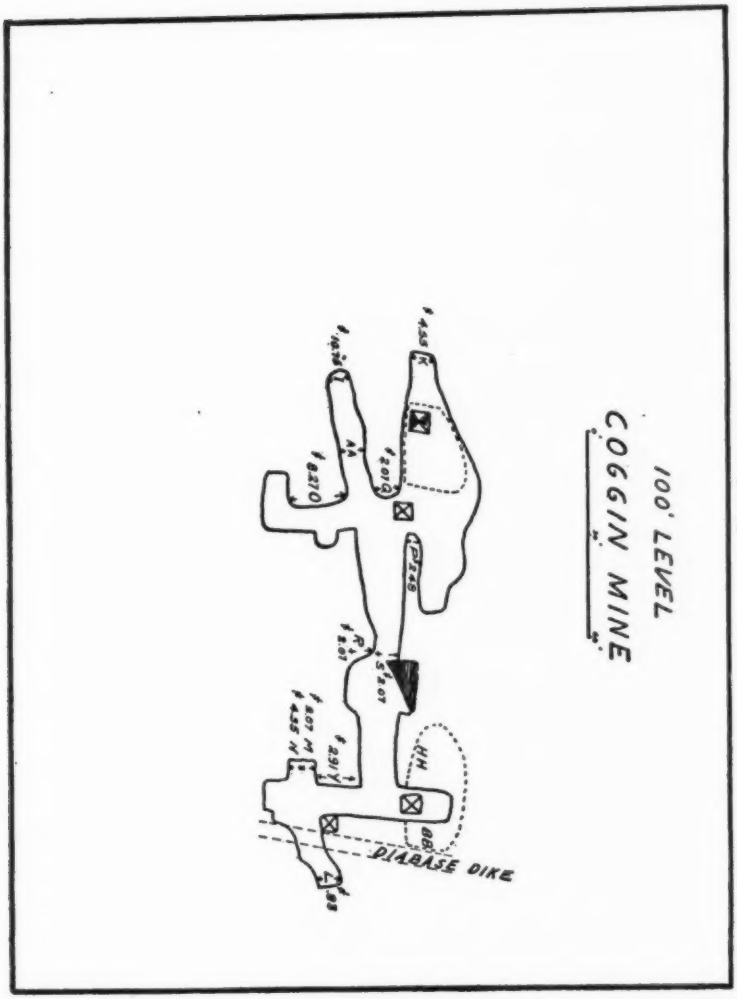


Figure 2

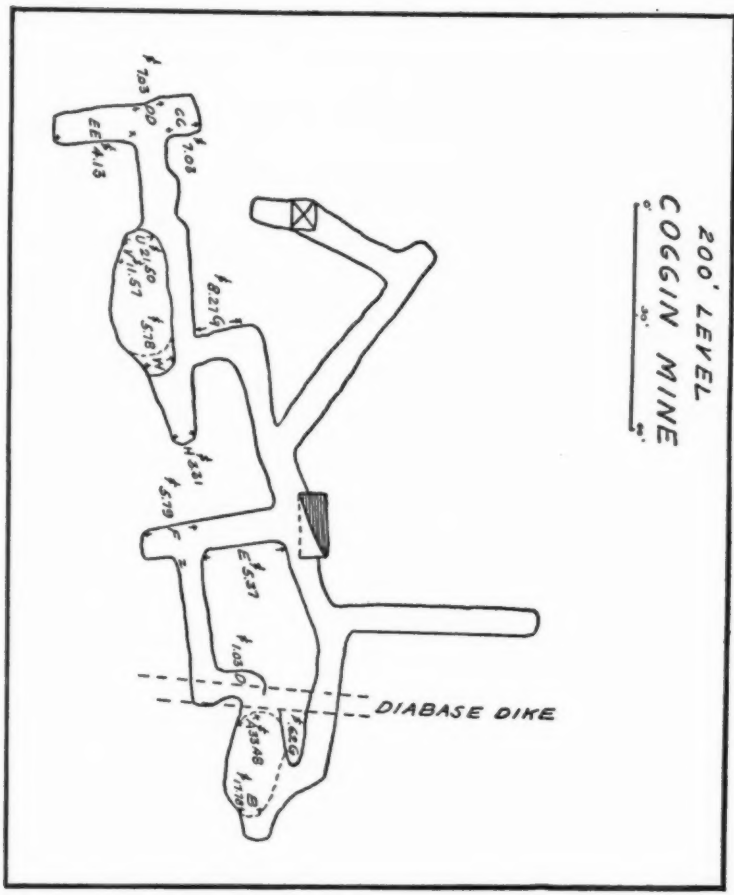


Figure 3

have come together on this 200-foot level. As assayed, an ore body is developed on this level 42 feet wide at the northeast portion of the level, which carries values of approximately $6 per ton for the whole width. The northeast stope is on the richer ore shoot that occurs in the vein, and has been stoped for a width of about 15 feet. The assays made of this ore shoot showed values varying from $5.82 to $21.54 per ton. The southwest stope of this level is on the richer portion of the ore body, just southwest of the diabase dike, and showed values of $17.82 and $32.52 per ton. This stope is about 12 feet wide. Between these two stopes, a distance of approximately 90 feet, there is a block of ore that has been developed by means of cross-cuts, that gave values varying from $3.38 to $8.30. There is apparently a seam of slate in this ore body that carries very low values. The whole body of ore, approximately 40 feet in width, will be found to carry approximately $5.50 to $6 per ton. The ore shoot to the southwest undoubtedly extends further to the southwest than has been developed.

It was impossible to get down into certain of the stopes in order to take samples at the bottom of the stopes between the 100- and 200-foot levels, and also the upper portions of the stopes from the 200-foot level. Two sides, however, of the block of ore between these two levels have been sampled and assayed, which will give an approximate value of the ore body; and this value has been used in reckoning the ore body.

250-*foot Level.*—At the 250-foot level a drift has been run a distance of 47 feet, N. 50° W. At a distance of 37 feet drifts were started northeast and southwest on a rich vein or seam of ore. As assayed, this seam carried from $170 to $232 in gold. Portions of it were rich, one 2-foot sample assaying $677 per ton. The material taken out of this cross-cut and the drifts show ore delivered to the mill on my last visit to the mine, January, 1914. The drifts from this cross-cut had only been extended a distance of 6 or 8 feet. A winze was started from the northeast stope of the 200-foot level to connect with the northeast drift on the 250-foot level. On account, however, of the difficulty in keeping good air in the winze, work was stopped on this, and an upraise will be made from the 200-foot level to connect with this winze.

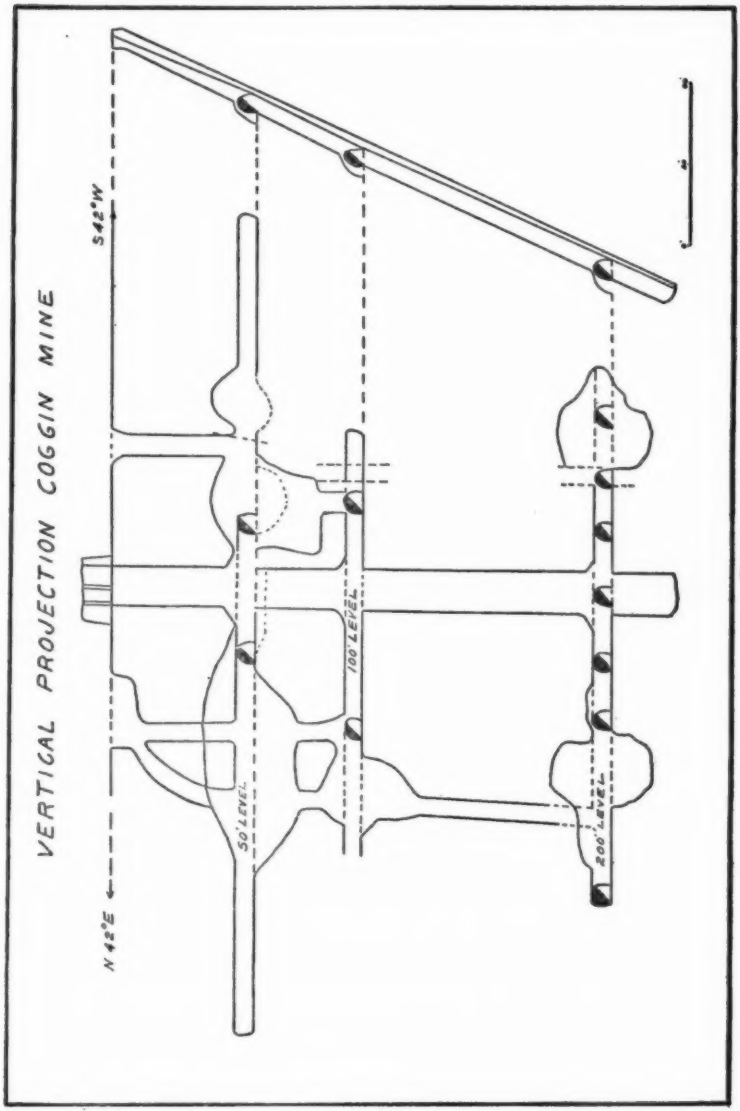

VERTICAL PROJECTION COGGIN MINE
S 42°W
N 42°E
50' LEVEL
100' LEVEL
200' LEVEL

Figure 4

The percentage of free gold in the ore at the 250-foot level is approximately the same as at the 200- and 100-foot levels. It is very interesting to note, and indicates that this type of ore is carrying free gold to considerably greater depth than had been expected.

Northeast Pit.—This pit, which is about 400 feet N. 42° E. from the main shaft, is 13 x 13 feet, and has been sunk to a depth of approximately 15 feet. This pit exposed the slates which, for a width of 6 feet, contained numerous seams and veins of quartz. The strike of the slates was approximately the same as that at the shaft, and their dipping, if anything, a little more vertical. All the slates were badly decomposed to the depth of the pit. A sample was taken from across the width of this open pit, and upon panning showed considerable free gold.

Southwest Pit.—This pit, which is at the extreme southwest portion of the 62-acre tract, has been sunk to a depth of about 6 to 8 feet alongside of a diabase dike. The strike of the schists that were exposed is approximately N. 43° E., and the strike of the dike approximately N. 20 to 30° E. A sample was taken of the slates as exposed in the pit just to the northeast of the dike; but, upon panning, this did not show any free gold, although some pyrite.

ASSAYS OF GOLD ORE, COGGINS MINE

Sample	Level	Description	Width	Value in Gold
A	200 ft.	Southwest stope	6 ft. 6 in.	$ 33.48
B	200 ft.	Southwest stope opposite end from A	5 ft. 10 in.	17.78
C	200 ft.	Just east stope, supposed wall rock	2 ft. 3 in.	.62
D	200 ft.	Just northeast of dike. All slate	10 ft.	1.03
E	200 ft.	West cross-cut from shaft. Mostly slate with seams of quartz	17 ft.	5.37
F	200 ft.	Last 12 ft. cross-cut. Northeast side	12 ft.	5.79
G	200 ft.	Cross-cut to northeast stope. Section east of stope	11 ft. 6 in.	8.27
H	200 ft.	Extreme southwest end of northeast stope	4 ft. 7 in	3.31
I	100 ft.	Extreme end. Almost western to the northeast drifts	4 ft. 6 in.	10.75
K	100 ft.	Extreme end of the easterly northeast drift	5 ft. 10 in.	4.55
L	100 ft.	Extreme southwest end just beyond diabase dike	4 ft.	.83
M	100 ft.	Southwest cross-cut. Slate 3ft. 3in.	3 ft. 3 in.	2.07
N	100 ft.	Next 5 ft. 8 in. beyond M	5 ft. 8 in.	4.55
O	100 ft.	Northeast cross-cut. Northeast side	9 ft.	8.27
P	100 ft.	Southwest end of northeast stope	6 ft. 2 in.	2.48
Q	100 ft.	Junction of two northeast drifts	8 ft. 5 in.	2.07
R	100 ft.	Just east of main shaft. Northeast side of chamber	9 ft. 6 in.	2.07
S	100 ft.	Nine ft. to the east of R, extending partly beyond shaft	9 ft.	2.07
T	100 ft.	2 ft. seam of quartz of S	2 ft.	1.65
U	200 ft.	5 ft. above bottom northeast stope, northeast end	5 ft. 10 in.	21 50
V	200 ft.	Just southwest U, 3 ft. to 4 ft. above bottom of stope	3 ft. 5 in.	11.57
W	200 ft.	Southwest end of stope. 3 ft. above bottom	8ft. 11 in.	5.78
Y	100 ft.	Southwest cross-cut. Northeast side of first 8 ft. of slate	8 ft.	2 91
AA	200 ft.	Westwardly northeast drift. 31 ft. 6 in. from face. Sample across roof	12 ft. 10 in.	10.33
CC	200 ft.	Extreme northeast cross-cut. East section	14 ft. 8 in.	7.03
DD	200 ft.	Same as CC. Next 10 ft. 10 in. to west	10 ft. 10 in.	7.03
EE*	200 ft.	Next 16 ft. 10 in. to DD to west	10 ft. 10 in.	4 13
A-2†	250 ft.	North side of cross-cut, 33 ft. from shaft	8 ft.	232.68
B-2	250 ft.	South side of cross-cut, beginning 33 ft. from shaft	8 ft.	171.51
C-2	250 ft.	South side of cross-cut, beginning 33 ft. from shaft	2 ft.	12.64
D-2	250 ft.	Next 2 ft. to C-2	2 ft.	218.99
E-2	250 ft.	Next 2 ft. to D-2	2 ft.	677.59
F-2	250 ft.	Next 3 ft. to E-2	3 ft.	70.38
G-2	250 ft.	North side cross-cut, beginning 3. ft. from shaft	3 ft.	258.90
H-2	250 ft.	Next 2 ft. to G-2	2 ft.	73.79
I-2	250 ft.	Next 2 ft. to H 2	2 ft.	10 02
J-2	250 ft.	Next 2 ft. to I-2	2 ft.	3.08
K-2‡	250 ft.	South side of cross-cut, last 3 ft. 2 in. of cross-cut	3 ft. 2 in.	1.26
L-2‡	250 ft.	Next 1 ft. 6 in. to K-2	1 ft. 6 in.	1.44

* Assays A to EE were made by Mr. Frank Drane, Charlotte, N. C.

† Assays A-2 to L-2 were made by Mr. Henry McCoy, Ophir, N. C.

‡ It was considered when these two samples were taken that they were beyond the ore-bearing seam, and the assays indicate this.

The ore bodies exposed in the Coggins Mine were carefully sampled and the location from which the samples were taken indicated by letters on the maps. (Figs. 2 and 3, pp. 171 and 172.)

In addition to the above samples, several other samples were taken, which were panned to determine whether or not the ore tested was carrying free gold, and the relative amounts. The panning samples were quartered and the amount panned usually weighed from 1 to 3 pounds. These samples were taken as follows:

Sample	Level	Description	Width	Value in Gold
Z	200 ft.	Quartz seam in drift from cross-cut in front of shaft.	2 ft.	Showed several nuggets of gold ¼ dwt. to 1 dwt. and many colors
BB	100 ft.	Southwest end of southwest stope. Material next to diabase dike.	2 ft.	Showed 3 good colors and many minute ones.
GG	100 ft.	Overhead southwest stope. Sample taken next to diabase dike.	9 ft.	Showed one good color, several minute ones. Several pyrite.
HH	100 ft.	Northeast portion of southwest stope to quartz seams.	2 ft.	Showed two fair colors and considerable fine gold
II	50 ft.	Extreme southwest end		Showed several small colors, some pyrite.
MM	50 ft.	Extreme northeast end beyond diabase dike.	4 ft. 10 in.	Showed no free gold. Some pyrite.
OO	50 ft.	Just southwest of diabase dike of southwest drift. Siliceous slate.	6 ft. 7 in.	Showed fair colors and many minute ones. Some pyrite.
PP	Surface	Pitt B	73 ft.	Many colors.
QQ	Surface	Pitt A	3 ft.	No gold.
XX	200 ft.	Northeast stope sample taken from material left on supposed hanging hall.	10 ft.	Nine fair colors. Many minute ones. Some pyrite.

A 10-stamp mill with four sets of amalgamation plates and two Wilfley concentrating tables has been erected. The ore as it is brought from the mine is raised to a hopper, from which it is fed to a Gates crusher, which feeds it onto an endless belt. This conveys the ore to the hopper, which feeds to the stamp mill. The capacity of the mill is approximately 30 tons per day.

There seems to be but very little tendency for the ore to slime, and a very good separation is obtained. One run of ore

from the winze that was being sunk from the 200-foot to the 250-foot level, which gave $19.75 on assaying, gave tailings assaying 90 cents. The ore from the 200-foot level, as it was delivered to the mill, asayed $53.20. Tailings from this ore assayed $4.35 on the first run. On the second run, where the ore assayed $54.02, the value of the tailings had been cut down to $2.88. The concentrates from the first run gave values of $133.03, and on the second run, $81.57. This, of course, is accounted for by the fact that the concentrates were not as clean as in the first run. The concentrates were carefully tested by panning, but showed no free gold. This was also true of the tailings, which indicates that there is a very complete amalgamation of free gold on the plates. The fineness of the Coggins gold, as determined in the Laboratory, was 904.

CHAPEL HILL, N. C.

CERTAIN MAGNETIC IRON ORES OF ASHE COUNTY*

BY JOSEPH HYDE PRATT

During the past six months the author has had the opportunity of examining several of the magnetic iron ore deposits of Ashe County, and to study in considerable detail their occurrence and the geology of the districts.

The deposits examined are located in the northeastern portion of Ashe County, principally along the north fork of New River and its tributaries that flow into it from the north. The deposits can readily be divided into three belts: one known as the "River Belt," another the "Poison Branch Belt," and the third, "The Helton Creek Belt."

While formerly these deposits were twenty or more miles from the railroad, the one now being built across Ashe County will bring the Ballou-Piney Creek, the Joseph Graybeal and Waughbank properties within a very short distance of the railroad.

These ores are all magnetic iron ores, occurring in crystalline rocks which consist principally of hornblende gneisses and schists and micaceous schists. The deposits of ore are undoubtedly lenticular or lens-shaped, and are pinching and widening in all dimensions. These lenses may continue for long distances along the strike and on the dip; then, again, there may be a series of smaller lenses separated from each other by country rock or connected with each other by a thin seam of ore. Sometimes they may be so small as to be of no commercial value; while at other times they attain enormous size, both in length and depth. Usually these ore deposits are comformable to the enclosing country rock. Each ore locality has to be investigated as a separate unit, inasmuch as there is great variation in them, and it does not follow that because one ore deposit is well developed that another one, even in the same belt, will be equally as good. These lenses have a general northeast-southwest trend.

The deposits examined include the Calloway and W. H.

* Reprinted from Economic Paper No. 34, of the North Carolina Geological and Economic Survey, pp. 65-73.

Brown properties of the "River Belt"; the Waughbank, the Graybeal, the Ballou-Piney Creek, Francis, McClure, Poison Branch, Falls, and Red Hill properties of the "Poison Branch Belt"; and the Kirby and Sturgill properties of the "Helton Creek Belt."

River Belt

The principal property examined in this belt is known as the Calloway property, the mineral interest of which is owned by Mr. Uriah Ballou. It adjoins a portion of the old N. B. Ballou property, the mineral interest of which is now owned by the Virginia Iron, Coal and Coke Company. The iron ore outcrops at the top of the hill, and has been developed by means of cuts and tunnels, so that the ore is exposed at various points from the top of the hill to the creek, 150 feet or more below. The principal development work on the Calloway property is a tunnel that was started about 140 feet below the top of the hill. This tunnel was extended in a N. 35° E. direction for a distance of 103 feet, when it encountered the iron ore. A cross-cut was made in order to determine the width of the ore, and it exposed a width along the cross-cut of 27 feet 8 inches, which would give a width across the vein of about 20 feet. The strike of the vein is approximately N. 45° E. The cross-cut, after penetrating the ore, was turned N. 70° E., and then 60° west, following the hanging wall until it again encountered the ore, which it followed for a distance of 17 feet 8 inches without penetrating the ore body. This gave a horizontal distance of about 30 feet along the vein. This same ore body outcrops at the surface at several places between this level and the top of the hill. By means of float and a few cross-cuts this ore belt can be traced in a southwesterly direction for a distance of about a mile across what is known as the Davis property and the Neaves property, when it crosses the north fork of New River. The deposit narrowed considerably, but where it crosses the river it is reported to have a width of 12 feet. On the Calloway property it is estimated that there is a distance of 450 feet of the vein from the tunnel to where it crosses onto the property owned by the Virginia Iron, Coal and Coke Company. Average samples of the ore as exposed in the tunnel were taken across the vein, where

cut by the cross-cuts. Results are given in analyses I and II of Table of Analyses.

The ore is very much mixed with gangue, but the magnetite can readily be separated from the gangue and largely concentrated by hand cobbing.

On the side of the hill controlled by the Virginia Iron, Coal and Coke Company sufficient crosscuts and tunnels have been made to show that the vein is continuous across the property.

POISON BRANCH BELT

The first property examined in this belt is known as the Poison Branch mine, the mineral interest of which is owned by Mr. Uriah Ballou and Mrs. Davis. The ore was encountered near the summit of a hill dividing the waters of Old Field and Silas creeks. Considerable work has been done on this property, part of which was to obtain ore for an old Catalan forge. This ore was obtained from two open cuts on the northeast side of the road, one on each side of the divide. Fifty feet below the summit a tunnel 181 feet in length was run into the hill, from which crosscuts were made: one at the extreme end of the tunnel; another 45 feet towards its mouth; and a third 114 feet from the end. The strike of the vein is approximately N. 40° E., and the dip about 45° S. E. Both the first two cuts cut across the vein for a distance of a little over 9 feet, which would give a vein of an actual width of 4½ to 5 feet. A third crosscut was run for a distance of over 33 feet, but this was as far as it could be entered at the present time, as it had been filled up with waste material from some other part of the mine. No ore could be seen in this crosscut. Average samples of this ore were taken, and the results are given under III in the Table of Analyses beyond.

The foot wall of this deposit is a mica schist, while the hanging wall is a hornblende gneiss.

This ore belt has been traced in a southwest direction from the Poison Branch property for a distance of about 3½ miles crossing the McClure, Blevins or Falls, Uriah and Graybeal properties. It is questionable whether the deposit itself is continuous, and it is more than apt to be made up of lenses of

magnetite, which may or may not be connected with each other. With the exception of the McClure property, the ore was observed in place on all of the properties. On this property, however, the cuts had become filled up so that no ore at all was exposed. Previous investigations, however, made by Mr. H. B. C. Nitze of the State Geological Survey showed conclusively the continuation of the magnetic iron ore belt across this property.

The Falls or Blevins Property.—This property, which was formerly known as G. Douglas Blevins property, is now owned and controlled by B. G. Falls and Charles Blevins, and is about 3 to 4 miles southwest of the McClure. The ore is exposed in a vein which outcrops in a ledge above Mr. Falls' house. The ore is a hard magnetite occurring in an epidote gneiss. There is also considerable of the epidote occurring as a gangue with the magnetite. An assay of this ore gave 43.29 per cent of iron. The vein as exposed on the outcrop of the ridge is about 8 feet wide. The strike is approximately N. 50° E., and the dip about 45° to the southeast. About 60 feet below the summit of the ridge a tunnel was run 60 feet into the hill, which cut but did not penetrate the vein. To the northeast of the vein on the same property there is another occurrence of magnetite that outcrops on the W. Jones property.

Ballou-Piney Creek Property.—About half a mile south, a little west of the Falls property, there is an occurrence of manganiferous magnetite on the Uriah Ballou land just above the waters of Piney Creek, about 1½ miles from it mouth. An open cut has been made here just below the road, which exposed 18 feet of ore, which would make the vein 12 feet across. The ore is very coarse grained, very free from gangue, but containing near its center a 15-inch seam or vein of soft brownish-black manganese-iron oxide. This ore was sampled and the analysis showed 64.56 per cent of metallic iron. For complete analysis see VI of table below. The soft brown ore was also analyzed, showing 42.80 per cent of metallic iron. See analysis VII in Table of Analyses.

About 85 feet above the cut described above the ore was exposed in a cut 4 to 5 feet deep. A granular ore, similar to the above, was found. The full width of the vein was not ex-

posed. A sample of this ore gave 65.50 per cent of metallic iron. See analysis V of table. About 40 feet still higher on the hill another cut 3 feet deep also exposed the same kind of ore. The lateral distance represented by the exposures made in the three cuts mentioned above is approximately 350 feet. The lead has been traced by means of float for a considerable distance beyond that exposed in the upper cut. The above all indicates that there is a lens of very large size on this property.

Ballou's Horse Creek, or Waughbank Property.—This property is about 1½ miles southwest of the Ballou-Piney Creek property on the north bank of Horse Creek. About 100 yards from the creek a tunnel was run by the Pennsylvania Steel Company. The tunnel has a direction of N. 40° E., and at a distance of 100 feet a crosscut was made extending 46 feet S. 40° W.

This crosscut showed ore for its whole distance, making the width of the ore deposit over 30 feet. This ore is composed of coarse granular magnetite in a matrix composed of micaceous material and manganese oxide. A rough estimate indicates that about 70 per cent of the ore body would represent the iron ore. This material was sampled and the results of the analysis are given in VIII-A in the table beyond. This mineral can readily be cobbed, which will raise the iron content. A sample was also analyzed of the magnetic iron portions of the vein, which gave 67.25 per cent of iron. The results of this analysis are given in VIII of the Table of Analyses.

Seventy-five to one hundred feet above the tunnel the vein was exposed in an open cut; but, on account of the cut having caved in, nothing definite could be determined in regard to the width of the vein.

Graybeal Property.—About one-half a mile northeast of the Waughbank property begins what is known as the Graybeal properties. The first property encountered is the Calvin Graybeal. Only a very little development work has been done on this property, but float ore has been encountered, which would indicate the continuation of the ore formation across the property.

A short distance north from the top of the hill on the Cal-

vin Graybeal property on lands owned by the Patton family and Calvin Graybeal, a cut exposed magnetic iron ore mixed somewhat with the country schist. This may be part of an ore deposit that is known in that section as the "North vein," which extends approximately parallel with the regular ore formation, and approximately 200 to 300 yards north of the larger vein.

It is about one-fourth mile from the top of the Calvin Graybeal hill to the Joseph Graybeal property in a general northeast direction. The vein has a strike across this property of an approximately northeast direction, and it is dipping toward the southeast. The ore deposit has been prospected and developed by means of open cuts, pits, and tunnels for a lateral distance of at least 800 feet and a vertical distance of over 100 feet. A drill hole was made by the Pulaski Iron Company at a point about 700′ to the southeast of the first open cut, and 75′ below. It is reported to have encountered the ore at a depth of about 200′. The dip of the vein would bring the ore body to this point. The width of the ore body as encountered varied from 4 to 15 feet.

The first cut examined was partially filled, so that the extent of the vein could not be determined. Good ore is exposed in the cut, thus showing the continuance of the ore body. This work was done by the Virginia Iron, Coal and Coke Company in 1907. Three hundred feet to the northeast another cut exposed the vein, which had a width of at least 15 feet of nearly solid ore, there being a little of the ore mixed with finely divided gangue rock. An analysis of this ore showed 63.50 per cent metallic iron. At the mouth of the cut, about 30 feet from the vein, another small seam of ore 12 to 15 inches thick was exposed. Most of this work was done about 1890 or 1892. Part of it was done in the early days of iron mining in the county, when the ore was obtained for Catalan forges.

Still further to the northeast a long open cut or trench was made by Mr. Sturgill in 1903 across the ore deposit. At the time of my visit, however, it was nearly all filled up, and the ore was only exposed at the east end of the cut.

Float ore has been found between all the cuts referred to.

On the opposite side of the hill several cuts and tunnels have

been run which penetrated the ore body, showing that the ore was continuous through this hill. Most of the work was done by the Virginia Iron, Coal and Coke Company in 1907. The first cut is about 300 yards northeast of the Sturgill cut referred to above. The first work done at this cut was in the early days to obtain ore for Catalan forges. Near the mouth of the cut an iron manganese seam of ore was encountered 6 feet wide, the distance between the two veins being about 30 feet. This ore was analyzed, and the results are given in XIV of the Table of Analyses. Its iron content was 63.15 per cent.

Thirty feet below this cut a tunnel was run into the hill. This was partially caved, so that it could not be examined except near its mouth, where a manganese iron vein was observed. Judging from the material found on the dump, the ore encountered in the tunnel was very similar to that in the cut referred to above.

Two hundred and fifty feet northeast of this tunnel another open cut was made by Dr. Tom Jones in 1905, and work was continued by the Virginia Iron, Coal and Coke Company in 1907. This cut exposed a seam of magnetite about 4 feet wide, which it penetrated. In the uper end of the cut there was exposed a mixture of pyrite and hornblende. Thirty feet below and 30 feet northeast of this cut a tunnel was run by the Virginia Iron, Coal and Coke Company, and later continued by Dr. Jones. This penetrated the ore body. There was exposed near the mouth of the tunnel a manganese iron seam of ore.

From this point it is 300 yards northeast to the Joseph Graybeal line. Beyond this property is the Dr. Thomas Jones land which has been prospected for the whole distance along the course of the ore by means of shallow cuts and pits. Only at one or two places was the ore exposed in place.

Henninger Property.—Adjoining the Dr. Jones property on the northeast and east are the Francis and Henninger properties. About 500 feet from the Dr. Jones line a small open cut was made, which showed granular magnetic ore. Six hundred feet northeast of the first opening another open cut shows similar ore. These two cuts were made by Mr. E. Sturgill about 1903 or 1904. These openings are near the barn of Mr. Eugene Ballou, who now owns the property.

Francis Property.—This property, which is between the Henninger and the Ballou-Piney Creek properties, has been developed to some extent by means of open cuts and tunnels, but at the time of my visit no ore could be observed in place. This ore was observed in place by Mr. H. B. C. Nitze of the North Carolina Geological Survey when he made an investigation of the Ashe County iron ores.

Red Hill Property.—The Red Hill property is near the northeast extension of the Poison Branch ore belt. The Red Hill rises about 170 feet above the level of the creek, and a trench over 200 feet in length has been made from one side of the hill to the other near its summit. While it did not expose a vein of solid magnetite ore, it did show a decomposed schistose rock, which carried almost throughout its entire extent masses and particles of magnetite scattered through it. There have been many openings made at various points on the hill which encountered magnetic iron ore. In some of the cuts more or less pyrite was observed, which will have a tendency to increase the sulphur content of the ore.

HELTON CREEK BELT

Kirby Mine.—This mine is located on the upper waters of Helton Creek, about one-half mile north of Sturgill postoffice and one-fourth of a mile from Helton Creek. The ore body on this property was exposed by a series of cuts made by the Pennsylvania Steel Company in 1902. One cut about 55 feet above a small branch showed ore exposed for a distance of 17 feet. Another cut 25 feet still higher on the hill showed a similar exposure of ore. This ore was in a gangue of epidote and hornblende. On the opposite side of the branch a long open cut was made by Mr. Sturgill in 1892. The mineral interest is owned by Mr. J. L. White and Sheriff Sturgill. Analysis of the ore is given in XVI of the Table of Analyses. The iron content of 43.10 per cent can easily be increased by hand cobbing.

There is given in the table below analyses of the ores from the various properties mentioned above.

TABLE OF ANALYSES

Locality	No.	Iron	Manganese	Silica	Phosphorus	Sulphur	Titanium	Analyst
Calloway Property	I	31.26		17.37	.028	.10		Drane*
Calloway Property	II	38.36						Drane
Poison Branch Property	III	45.25		20.65	.052	1.58	trace	C. & M.†
Falls Property	IV	43.25						C. & M.
Ballou-Piney Creek Property, upper-cut	V	65.50	2.81					C. & M.
Ballou-Piney Creek Property, near creek	VI	64.56	2.59	2.06	.014	trace	none	Drane
Ballou-Piney Creek Property, Mn-Fe vein	VII	42.80	17.48					C. & M.
Waughbank Property	VIII	67.25	1.68					C. & M.
Waughbank Property, Magnetite	VIII-A	46.25	4.34		.026	.027	trace	C. & M.
Graybeal Property, first cut	XI	67.40		1.15	.005	.060	none	C. & M.
Graybeal Property, second cut	XII	63.50						C. & M.
Graybeal Property, large cut at top hill	XIV	63.15	3.58					C. & M.
Kirby Mine	XVI	43.10		21.76	.057	.036	trace	C. & M.

* Frank Drane, Chemist, Charlotte, N. C.
† Crowell & Murray, Chemists, Cleveland, Ohio.

As will be seen from the above analyses, there is considerable variation in the metallic contents of the ore, but the iron content is good, and as they are all comparatively low in sulphur, phosphorus, and titanium, they will, therefore, make iron ores of high value.

Analyses I and II of ore from the Calloway property are low in iron, but they represent samples taken across the full width of the ore deposit, including gangue and waste. By hand cobbing this ore can readily be raised to a 55 to 60 per cent iron ore. The magnetite portion of the vein gives as high as 65 per cent metallic iron.

The ores represented by analysis III, IV, and VIII-A can also be easily concentrated by hand cobbing.

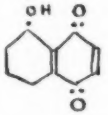
All the ores tested are a splendid grade of magnetite, and should make a pig iron of exceptional quality.

CHAPEL HILL, N. C.

THE ISOMERISM OF THE HYDROJUGLONS*

RICHARD WILLSTAETTER AND ALVIN S. WHEELER

Thanks to the splendid researches of A. Bernthsen[1] and F. Mylius,[2] the uncertainties of the constitution of juglone have been fully cleared up. The decomposition of juglone into β-hydroxyphthalic acid and its synthesis from 1, 5-dihydoxy-naphthalene indicates that its structural formula is that of 8-hydroxy-1, 4-naphthoquinone:



The study of the two hydrojuglones however remained incomplete in certain important points, especially in regard to their isomerism.

Mylius isolated two isomeric compounds, α- and β-hydrojuglone, from green walnut shells. The first, which possesses the higher melting point, is a true hydroquinone and oxidizes easily to juglone. The β-compound however does not pass directly into juglone. According to Mylius the two hydrojuglones can be converted into each other in different ways. For example, the α-form can be changed into the β-form by distillation or by the hydrolysis of its acetyl derivative. The β-form may be turned back into its isomer by heating a solution of it in alcoholic dilute hydrochloric acid. Mylius explained the relations between the two isomers as position isomerism. He stated that one of the para hydroxyl groups in the α-hydrojuglone changed its location in the nucleus of the disubstituted benzene ring. This explantion was plausible for nearly thirty years but the easy mutual transformations of the isomers are in our view opposed to this theory.

We find it is not necessary to distill the α-hydrojuglone in

* Translated from Ber. der deutsch. chem. Gesell., 47,2796 (1914).

[1] Ber. der deutsch. chem. Gesell., 17,1945 (1884); Bernthsen and Semper, *ibid*, 18,203 (1885); 19,164 (1886), 20,934 (1887).

[2] Ber. der deutsch. chem. Gesell., 17,2411 (1884); 18,463,2567 (1885); also Habilitationsschrift, Freiburg i. B., 1885.

order to isomerize it. One needs only to heat until it melts in order to obtain an equilibrium out of which one can readily isolate nearly three-fourths as the β-compound. In order to convert this into the α-form it is sufficient to dissolve it in alkali with the exclusion of air and then to acidify. This is not a case of the wandering of an hydroxyl group but rather a case of keto-enol isomerism.

α-Hydrojuglone is a true trihydroxynaphthalene (1, 4, 8). Its solutions are distinguished by a very strong fluorescence. β-Hydrojuglone is the keto form of it in which one of the two hydroxyl groups in the para positions has experienced a transformation into a carbonyl group, according to one of the following formulas:

We are able to support this view since we have obtained well crystallized semicarbazones of β-hydrojuglone with semicarbazine and with phenylsemicarbazine while analogous derivatives of α-hydrojuglone could not be obtained. An oxime of β-hydrojuglone was also observed but a closer study of it has not been undertaken. That the two isomers yield the same triacetyl and tribenzoyl derivatives is in agreement with this conception. But it does not well explain the behavior of these derivatives on hydrolysis. The acetyl compounds yield β-hydrojuglone by the action of strong sulfuric acid, while α-hydrojuglone according to Mylius is not transformed into its isomer by sulfuric acid.

The isomerism of the hydrojuglones is the first case if keto-enol isomerism of a phenol in the naphthalene series. It ranges itself alongside the desmotropic phenomena of the meso-phenols of the anthracene series (dianthranol, anthranol and anthrahydroquinone) which Hans Meyer[3] and especially Kurt H. Meyer[4] have described in their important investigations.

[3] Ber. der deutsch. chem. Gesell., 42,143 (1909); Monatsh., 30,165 (1909).
[4] Ann., 379,37 (1910-'11); Meyer and Sander, Ann., 396,133 (1913).

PREPARATION OF JUGLONE

We found that the oxidation of 1, 5-dihydroxynaphthalene according to Bernthsen and Semper[5] was the best method for the preparation of juglone although we were unable to secure a higher yield of the pure quinone than sixteen per cent. 1, 5-Dihydroxynaphthalene was purified by dissolving in ether and reprecipitating in petroleum ether. It forms colorless prisms which melt at 254°. 50g 1, 5-Dihydroxynaphthalene, after rubbing up with a small quantity of water, are introduced in small portions into a chromic acid mixture consisting of 240g sodium bichromate, 340g concentrated sulfuric acid and 3400cc water. The temperature is not allowed to rise above 10°. On the following day the brownish yellow precipitate is filtered off, dried and boiled up with ligroin, 70-80°. The impurities remain undissolved and the extracts upon concentration yield 8.8g juglone in the form of deep yellow needles. They show a melting point of 149-50°, when the substance is introduced into a bath previously warmed to 140°.

We found that juglone could also be obtained from 1, 5-dihydroxynaphthalene by oxidation with lead peroxide. The yield is somewhat higher but the process is not practical. It is noteworthy how much the yield here depends upon the quantity of the solvent and of the oxidant on the surface of which the oxidation takes place. 100g Lead peroxide in one liter of benzene yields the same quantity of juglone whether 5g or 0.5 g dihydroxynaphthalene are used. 0.5g 1, 5-Dihydroxynaphthalene are boiled five hours in one liter of benzene with 100g good lead peroxide. The beautiful yellow solution is concentrated in vacuum to 10cc and mixed with petroleum ether. 0.15g Juglone crystallizes out in pure yellow needles.

0.1252g Substance gave	0.3143g CO_2;	0.0402g H_2O
Calculated for $C_{10}H_6O_3$:	C, 68.95;	H, 3.47
Found	C, 68.46;	H, 3.59

1, 8-Dihydroxynaphthalene does not yield juglone on oxida-

[5] Ber. der deutsch. chem. Gesell., 20,938 (1887).

tion. The statements of H. Erdmann[6] on its formation by means of chromic acid are erroneous. P. Friedlaender and S. Silberstern[7] obtained juglone by coupling 1, 8-aminonaphthol with diazobenzenesulfonic acid, followed by reduction and oxidation. It was suggested that 1, 8-dihydroxynaphthalene might serve as the raw material.

The formation of monoazo dyestuffs from it proceeds most smoothly in aqueous alcohol solution if less than the theoretical quantity of the diazo compound is employed. 5g Dihydroxynaphthalene are dissolved in 300cc alcohol and coupled with 2.5g diazobenzenesulfonic acid at a low temperature. After twelve hours the alcohol is boiled off and the dyestuff is salted out with a little salt. To remove any dihydroxynaphthalene it is washed with alcohol. It crystallizes from dilute alcohol in garnet red quadratic plates. It dissolves considerably in water but is difficulty soluble in alcohol.

0.2060g Substance gave 0.1398g $BaSO_4$	
Calculated for $C_6H_{12}O_5N_2S$:	S, 9.32
Found	S, 9.32

The dyestuff is stirred up with much excess of sulfuric acid and zinc dust is added until it is decolorized. The filtrate which is still strongly acid is cooled and treated with an excess of ferric chloride in one portion. Juglone crystallizes out, 1.4g being obtained from 3.0g dyestuff. The product, however, was seldom pure. After recrystallization the yield usually dropped to 0.5g to 0.6g.

α- AND β-HYDROJUGLONE

α-Hydrojuglone, whether it is obtained from green walnut shells, or by the reduction of juglone or by the transformation of β-hydrojuglone, differs in one point from the statements of Mylius, for we find that the melting point of all our preparations is 148° whereas Mylius found it to be 168-70°. We do not doubt but that a satisfactory explanation of this difference will yet be found.

[6] Ann., 247,358 (1888). Also the statement in Beilstein, III, 380, that juglone according to M. Kawalski is formed from α-naphthol in alkaline solution by means of atmospheric oxygen, is incorrect. This author, Ber. 25, 1660 (1892) is describing here the ordinary hydroxynaphthoquinone.

[7] Monatsh., 23,513 (1902).

We could not confirm the statements in the literature[8] that juglone is reduced by sulfurous acid. The best method of reduction is with zinc and sulfuric acid in the following way. 5g Juglone are suspended in a separatory funnel with about 50cc ether and an under layer of 2N- sulfuric acid. Zinc dust is added in small portions, followed by vigorous shaking, until the ether layer becomes colorless, though exhibiting a strong greenish fluorescence. After removal of the ether solution, the aqueous layer and zinc dust are shaken out twice with ether. The etheral solution is dried with sodium sulfate, concentrated under diminished pressure and mixed with considerable petroleum ether. The precipitated substance did not change its melting point of 148° after reprecipitation from ether by petroleum ether or after recrystallization from water. It corresponded in its other properties to the careful description of Mylius.

0.1993g Substance gave 0.4956g CO_2 and 0.0825g H_2O
Calculated for $C_{10}H_8O_3$: C, 68.16; H, 4.58
Found C, 67.82; H, 4.63

Mylius transformed it into its lower melting isomer by distillation in an atmosphere of hydrogen. It is sufficent however, as we found, to simply melt the α-compound in an evacuated flask. After keeping it in a melted condition 10 minutes in a bath at 160-70°, a yield of 70 per cent of β-hydrojuglone was obtained. It was found best to extract the cooled product with carbon tetrachloride in which the α-compound is much more completely insoluble than in chloroform. The carbon tetrachloride solution was concentrated in vacuum and the β-hydrojuglone recrystallized from alcohol or petroleum ether. It forms six sided plates, melting at 96-7°.

The transformation into the α-compound is readily carried out, as Mylius stated, by heating with alcoholic aqueous hydrochloric acid. It is also successfully obtained by dissolving the β-compound in dilute sodium hydroxide, containing a little stannous chloride, and acidfying.

[8] Ber. der deutsch. chem. Gesell., 17,1946 (1884).

SEMICARBAZONE OF β-HYDROJUGLONE

$C_{10}H_8O_2$: N. NH. CO. NH_2

Warm alcoholic solutions of β-hydrojuglone (3g in 65cc) and of semicarbazine (1.5g in 35cc) are mixed and a bottle is filled to the stopper with the solution and closed. After four days dark yellow hard globular crystals, weighing 3.8g, have crystallized out. They are washed with alcohol and recrystallized from much boiling benzene. Only one half of the product could be brought into solution, an insoluble amorphous substance remaining behind. The semicarbazone forms beautiful feather like groups of needles or sharply truncated prisms of pale yellow color which melt at 197-8° with decomposition. The compound is easily soluble in hot acetic acid, difficulty soluble in alcohol and in benzene, insoluble in ether and in ligroin.

0.1460g Substance gave 0.3062g CO_2 and 0.0650g H_2O
0.1307g Substance gave 21.4cc N at 18° and 713mm
Calculated for $C_{11}H_{11}O_3N_3$: C, 56.65; H, 4.72; N, 18.03
Found C, 57.19; H, 4.98; N, 17.86

PHENYLSEMICARBAZONE OF β-HYDROJUGLONE

$C_{10}H_8O_2$: N. NH. CO. NHC_6H_5

We mixed cold saturated solutions of β-hydrojuglone (1g) and phenylsemicarbazine (1.1g) in absolute alcohol. The reaction product began to separate within a half an hour and the separation was complete in 24 hours. The phenylsemicarbazone formed a pulpy mass of bright yellow needles in star shaped groups. The yield amounted to 1.7g. By recrystallization from considerable boiling acetone (350cc required by 1g) or from xylene long thin needles were obtained which carbonized at 243° without melting.

0.1687g Substance gave 0.4090g Co_2 and 0.0744g H_2O
0.1046g 12.9cc N, dry, at 25° and 721mm
Calculated for $C_{17}H_{15}O_3N_3$: C, 66.03; H, 4.85; N, 13.59
C, 66.12; H, 4.90; N, 13.40

The phenylsemicarbazone is insoluble in ether, in alcohol

and in benzene, difficulty soluble in hot benzene. It is resolved into its components by boiling with sulfuric acid.

NOTE:—The work described in this paper was carried out in the Organic Laboratory of the Federal Polytechnic Institute, Zurich, Switzerland.

LIST OF REPTILES AND AMPHIBIANS OF NORTH CAROLINA

BY C. S. BRIMLEY

The following list is a brief summary of the records of reptiles and amphibians from North Carolina, contained in a card catalogue of the same which I have kept for a number of years. The records are drawn from the following sources:

1. Published Records. (See Bibliography at end of this paper.)

2. Specimens received by the State Museum at Raleigh, for which I am indebted to my brother, H. H. Brimley, Curator.

3. Specimens collected at various points in North Carolina by Messrs F. Sherman, H. H. Brimley, Z. P. Metcalf and myself.

4. Specimens in the Biological Laboratory of the University of North Carolina, for the pleasure of examining which I am indebted to Dr. W. C. Coker, and Dr. H. V. Wilson.

Those species of which I have not seen North Carolina specimens are marked with a star (*).

I. TAILED AMPHIBIANS (SALAMANDERS)

1. *Siren lacertina* (Great Siren). New Bern and Lake Ellis in Craven County, Edenton, Collington's Island (just north of Roanoke), apparently not common.

2. *Necturus maculatus* (Water Dog). Raleigh, Kinston, Tarboro, Chapel Hill, not common.

*3. *Necturus punctatus* (Southern Water Dog). Wilmington, two specimens sent to U. S. National Museum in March, 1882 by Donald MacRae.

4. *Amphiuma means* (Ditch Eel). Raleigh, Halifax, Clayton, Cape Hatteras, Bertie Co., Tarboro, Bladen Co., Lake Ellis, common in lowland swamps.

5. *Cryptobranchus alleghaniensis* (Hellbender). Found in the mountain streams. I have seen specimens from Cherokee and Yancey counties.

*6. *Amblystoma jeffersonianuum* (Jefferson's Salamander).

"Very numerous under logs below the fir belt on Roan Mt." S. N. Rhoads in Proceedings of Academy of Natural Sciences of Philadelphia, 1895, p. 402.

7. *Amblystoma opacum* (Marbled Salamander). Raleigh, Kinston, Tarboro, Salem, Greensboro, Chapel Hill, Lake Waccamaw, not uncommon.

8. *Amblystoma punctatum* (Spotted Salamander). Raleigh, Greensboro, Chapel Hill, and Andrews (Cherokee County).

*9. *Amblystoma talpoideum* (Mole Salamander). "Abundant in the high valley in southwestern North Carolina, in which the French Broad river takes its origin from mountain streams." Cope, Batrachia of North America, page 53.

10. *Amblystoma tigrinum* (Tiger Triton). About twenty-five received from Sanford in mid-January, 1893. A specimen without data in Biological Laboratory of State University.

11. *Diemyctylus viridescens* (American Newt). Raleigh, Chapel Hill, Kinston, Blantyre (Transylvania Co.), Highlands, Grandfather Mt., and Sunburst (Haywood Co.), Common.

*11a. *Diemyctylus viridescens vittatus* (Wilmington Newt). Wilmington (type locality), H. Garman, Journal Cincinnati Society of Natural History, 1897, pp. 49-51.

12. *Desmognathus fusca* (Brown Triton). Raleigh, Lake Ellis, Chapel Hill, Salem, Kinston, abundant.

*13. *Desmagnathus nigra* (Black Triton). Roan Mt., two adults taken by Rhoads.

14. *Desmagnathus ochrophea* (Round-tailed Triton). Abundant in the mountains mostly above 3,500 feet. Taken in Haywood, Macon, Transylvania, Buncombe, and Yancey counties and on Grandfather Mt., occuring up to at least 6,500 feet. In streams and rotten logs.

15. *Desmognathus quadrimaculatus* (Mountain Triton). Abundant in the mountains from about 3,500 feet up, in streams. Taken in Haywood, Buncombe, Yancey, Transylvania, Macon, Cherokee and on Grandfather Mountain.

*16. *Leurognathus marmoratus* (Moore's Triton). Grandfather Mountain (type locality), three taken by Dr. Moore in pool in stream on south side of mountain in July 1898. (Proc. Ac. Nat. Sc. Phila. 1899, p. 316.

17. *Plethodon erythronotus* (Red-backed Salamander). Taken by Sherman at Greenville in Pitt County, April 4, 1902. Also recorded from four mountain localities, Roan Mt., Black Mt., Andrews (Cherokee Co.), and Sunburst (Haywood Co.) Apparently not common.

18. *Plethodon glutinosus* (Viscid Salamander). Common in all parts of the state, but not apparently ranging above 3,500 feet in the mountains. Recorded from Littleton, Greenville, Raleigh, Chapel Hill, Lake Ellis, and Lumberton in the east and from the counties of Haywood, Transylvania, Buncombe, and Yancey and from Grandfather Mountain in the west.

19. *Plethodon metcalfi* (Unspotted Salamander). Common above 3,500 feet at Sunburst in Haywood County (type locality), and also on Grandfather Mountain. Two taken at Highlands and two more on the Tuskwitty Range between Andrews and Aquone in May, 1908. Occurs up to 6,000 feet at least.

20. *Plethodon shermani* (Red-legged Salamander). Taken only on the Wayah Bald Mountain, between Franklin and Aquone, (type locality). See Proc. Biol. Soc. Wash., XXV, P. 135.

21. *Manculus quadridigitatus* (Dwarf Salamander). Raleigh and Kinston, not uncommon. Terrestrial, except in the breeding season which is in January.

22. *Stereochilus marginatus* (Margined Salamander). Lake Ellis, common.

23. *Spelerpes bilineatus* (Striped Salamander). Raleigh, Salem, and in the mountains up to 5,500 feet. (Yancey, Buncombe, Haywood, Cherokee, Mitchell, Macon, and Transylvania counties and on Grandfather Mountain.)

24. *Spelerpes guttolineatus* (Holbrook's Triton). Raleigh, Salem, Andrews (Cherokee Co.), and Weaverville (Buncombe Co.) Not noted over 2,500 feet.

25. *Spelerpes danielsi* (Daniel's Triton). Blantyre (Transylvania Co.), Sunburst (Haywood Co.), and Cane River Yancey Co.), Eleven in all taken, none above 3,500 feet.

26. *Spelerpes ruber* (Red Triton). Raleigh, Goldsboro, Beaufort, Salem, Chapel Hill, Hillsboro and Summerville. Also recorded from some mountain localities, but these probably

refer to the next. Specimens from Cane River and Burnsville in Yancey county are apparently this form.

27. *Spelerpes schencki* (Black-lipped Triton). Sunburst, Blantyre, Highlands, Andrews, Wayah, Bald Mountain, and Aquone. Apparently replaces S. ruber in the mountains. Not observed above 4,000 feet elevation.

28. *Gyrinophilus porphyriticus* (Purplish Salamander). Roan Mt. (Rhoads), and Black Mt. (Sherman, larvae).

II. TAIL-LESS AMPHIBIANS (FROGS AND TOADS)

29. *Acris gryllus* (Cricket Frog). Raleigh, Lake Ellis, Chapel Hill, Greensboro, Southern Pines. Abundant.

30. *Chorophilus feriarum* (Chorus Frog). Raleigh, Greensboro, Chapel Hill, abundant. Normally commences breeding in February.

31. *Hyla cinerea* (Carolina Tree Frog). Cape Hatteras, July, 1905, (H. H. Brimley). Kinston (Cope).

32. *Hyla femoralis* (Pine woods Tree Frog). Wilmington, December 1901, Lake Ellis, May 1907 (Sherman).

33. *Hyla pickeringi* (Peeper). Occurs from Lake Ellis to the mountains. Lake Ellis, Dover, Goldsboro, Raleigh, Chapel Hill, Greensboro, Andrews, Blantyre, Toxoway, Aquone, Highlands, Black Mountain, and Roan Mt. Highest recorded elevation 6,300 feet on Roan Mountain (Rhoads).

34. *Hyla squirella* (Squirrel Tree Frog). Cape Hatteras, January 1903 (F. Sherman), Lake Ellis, July 10, 1905, (C. S. B.), and Southport, October 1906 (Sherman).

35. *Hyla versicolor* (Common Tree Frog). Raleigh, Greenville, Chapel Hill, Goldsboro, Summerville and Tarboro, common.

36. *Scaphiopus holbrooki* (Solitary Spadefoot). Raleigh, common, but seldom seen except when breeding, which happens some time in spring or summer, usually when a warm rain is falling. Have been noted breeding in March, April, May, June, and August.

37. *Bufo americanus* (Common Toad). Our only positive records are from Sunburst (Haywood Co.) and Black Mountain. Apparently the common toad of the state is the next.

38. *Bufo fowleri* (Fowler's Toad). According to Miss M. C. Dickerson, author of the "Frog Book", our Raleigh toads are this species as are also two out of three specimens from Black Mt. Chapel Hill, University collections.

39. *Bufo quercicus* (Dwarf Toad). Kinston (Cope), Beaufort (Sherman), and Lake Ellis (C. S. B.) Not common.

40. *Engystoma carolinense* (Narrow-mouthed Toad). Raleigh, Dover, Goldsboro, and Southern Pines. Breeds from May to August, common, but nocturnal and subterranean, and hence seldom seen.

41. *Rana catesbiana* (Bullfrog). Raleigh, Lake Ellis, Tarboro, Cape Hatteras, Chapel Hill, and Hendersonville.

42. *Rana clamata* (Spring Frog). Lake Ellis, Raleigh, Chapel Hill, Greensboro, Salem, Blantyre (Transylvania Co), Black Mt., Roan Mt., and Sunburst (Haywood Co).

43. *Rana palustris* (Pickerel Frog). Raleigh, Roan Mt., and Kinston. Apparently increasing in numbers at Raleigh, though not common.

44. *Rana sphenocephala* (Southern Leopard Frog). Raleigh, Lake Ellis, Cape Hatteras and Tarboro. This and *clamata* are the two commonest *Ranae* at Raleigh.

*45. *Rana sylvatica* (Wood Frog). Kinston (Cope).

46. *Rana virgatipes* (Carpenter Frog). Lake Ellis, Wilmington, the latter locality added on the authority of Mr. W. T. Davis who heard them near here in the spring of 1914.

III. LIZARDS

47. *Anolis carolinensis* (Green Lizard, "Chameleon"). Apparently common throughout the whole region east and south of Raleigh, but does not occur at Raleigh. Wilmington, Lumberton, Carthage, Southport, Smith's Id., Lake Ellis, Beaufort, Kinston, Willard (Pender Co.), Wakefield (Wake Co.), Summerville (Harnett Co.), White Lake (Bladen Co.), Albemarle (Stanly Co.), and Tryon (Polk Co.).

48. *Sceloporus undulatus* (Fence Lizard). Common, Raleigh, Chapel Hill, Lumberton, Summerville, Tarboro, Wilmington, Kinston, Salem, Blantyre (Transylvania Co.), Hendersonville, Toxoway, Franklin (Macon Co.), Andrews (Chero-

kee Co.), Black Mt., Sunburst (Haywood Co.). Does not appear to range over 3,000 feet in the mountains.

49. *Cnemidophorus sexlineatus* (Sand Lizard). Common, ranging in the mountains up to about 2,500 feet. Raleigh, Chapel Hill, Kinston, Brunswick Co., Southern Pines, Black Mt., and Andrews.

50. *Ophisaurus ventralis* (Glass Snake). Chapel Hill, Raleigh, Garner (Wake Co.), Southport, Beaufort, Wilmington, New Bern, Washington, White Lake (Bladen Co.), and Statesville. Confined mainly to the eastern part of the state, not common.

51. *Leiolepisma laterale* (Ground Lizard). Raleigh, Lake Ellis, Chapel Hill, Kinston, Salem, not uncommon, but secretive in habits.

52. *Eumeces quinquelineatus* (Bluetailed Lizard, "Scorpion"). Raleigh, Chapel Hill, Lumberton, Lake Ellis, Kinston, New Bern, Blantyre, Andrews, Franklin, ranging up to 3,000 feet at least.

IV. HARMLESS SNAKES

53. *Abastor erythrogrammus* (Rainbow Snake). New Bern, Wilmington, Kinston, Lake Ellis, Edenton, not common.

54. *Bascanium constrictor* (Black Snake). Raleigh, Chapel Hill, Lake Ellis, Washington, Statesville, Blantyre and Black Mountain. Common.

55. *Bascanium flagellum* (Coach whip). Southern Pines, Lake Ellis, White Lake (Bladen Co.), and Pender Co., one specimen from each locality.

56. *Carphophiops amoenus* (Worm Snake). Lake Ellis, Raleigh, Chapel Hill, Washington, Kinston, Blantyre, Andrews, and Sunburst. Common in rotten stumps and logs.

57. *Cemophora coccinea* (Scarlet Snake), Raleigh, Southern Pines, Washington, not common, in the eastern part of the state only.

58. *Coluber guttatus* (Spotted Racer; Corn Snake). Eastern part of state, not common. Raleigh, Washington, Lake Ellis, Southern Pines.

59. *Coluber obsoletus* (Black Chicken Snake). Western

two thirds of state, not uncommon. Raleigh, Chapel Hill, Kinston, Taylorsville, Andrews (Cherokee Co.), Sunburst (Haywood Co.)

60. *Coluber quadrivittatus* (Stripped Chicken Snake). Eastern part of state. New Bern, Cape Hatteras, Lake Ellis, Pender Co., Maysville (Jones Co.), White Lake (Bladen Co.)

61. *Cyclophis aestivus* (Southern Green Snake). Common, arboreal, on low bushes and coarse herbage. Bertie Co., Tarboro, Kinston, Beaufort, Cape Hatteras, Southern Pines and Chapel Hill.

62. *Diadophis punctatus* (Ring-necked Snake). Apparently whole state, common. Lake Ellis, Raleigh, Chapel Hill, Summerville, Blantyre (Transylvania Co.), and Sunburst.

63. *Eutaenia saurita* (Ribbon Snake). Wilmington, Raleigh, Avoca, Summerville, and Toxoway.

64. *Eutaenia sirtalis* (Garter Snake). Raleigh, Chapel Hill, Kinston, Jackson, (Northampton Co.), Cane River (Yancey Co.), and Sunburst. Common.

65. *Farancia abacura* (Horn Snake). Eastern section only. New Bern, Wilmington, Whiteville (Columbus Co.), Currituck, White Lake, and Lake Ellis.

66. *Haldea striatula* (Ground Snake). Raleigh, Summerville, Lumberton, Bertie Co., Lake Ellis. Common.

67. *Heterodon platyrhinus* (Spreading Adder). Wilmington, Goldsboro, Kinston, Beaufort, Chapel Hill, Raleigh, Summerville, Southern Pines, Washington, and Black Mountain, also Statesville. Common. Black specimens are occasional.

68. *Heterodon simus* (Hog-nosed Snake). Goldsboro, Lake Ellis, and Wake Co., not common.

69a. *Natrix fasciata fasciata* (Southern Water Snake). Eastern section, less common than the next. New Bern, Wilmington, Lake Ellis, and Raleigh.

69b. *Natrix fasciata sipedon* (Northern Water Snake). The common water snake of the whole state. Wilmington, Kinston, Cape Hatteras, Goldsboro, Royal Shoals (Pamlico Sound) White Lake, Washington, Salem, Black Mountain, Cane River, Sunburst, Andrews, Raleigh and Chapel Hill.

69c. *Natrix fasciata erythrogastra* (Red-bellied Water

Snake, "Copperbelly"). Not common, Kinston, Lake Ellis, Raleigh, White Lake, Jackson (Northampton Co.).

70. *Natrix taxispilota* (Pied Water Snake), Kinston, Avoca, Lake Ellis, White Lake, New Bern, Cape Hatteras, and Pender Co. Common in the east.

71. *Natrix leberis* (Willow Snake, Queen Snake). Raleigh, Chapel Hill, Kinston, Waynesville, Blantyre, Cane River. Not common.

72. *Ophibolus doliatus coccineus* (Red King Snake) Summerville, Chapel Hill, Raleigh, not uncommon.

73. *Ophibolus doliatus triangulus* (Milk Snake). Sun burst (Haywood Co.), two specimens.

74. *Ophibolus getulus* (King Snake). Raleigh, Chapel Hill, Lake Ellis, New Bern, Kinston, Washington, Brunswick Co., Homestead (Graham Co.), Patterson (Caldwell Co.), Blantyre (Transylvania Co.) Common.

75. *Ophibolus rhombomaculatus* (Brown King Snake). Raleigh, Chapel Hill, Jackson, Washington, Statesville. Not common.

76. *Pityophis melanoleucus* (Pine Snake, Bull Snake). Two received alive by State Museum from Bushnell, Swain Co., in August 1909.

*77. *Rhadinaea flavilata* (Brown-headed Snake). Fort Macon (Cope).

78. *Storeria dekayi* (DeKay's Snake). Raleigh, Chapel Hill, Kinston, and Cherokee. Common.

79. *Storeria occipitomaculata* (Red-bellied Storeria). Raleigh, Southern Pines, Chapel Hill, Cranberry. Less common than preceding.

80. *Virginia valeriae* (Valeria's Snake). Raleigh, Chapel Hill, Statesville, and Andrews. Not common.

V. POISONOUS SNAKES

81. *Tantilla coronata* (Crowned Tantilla). Raleigh, May 6, 1906, Southern Pines, May, 1909, also a specimen in the Zoological Laboratory of the University of North Carolina without data, possibly from Beaufort. Our only Dipsadine snake.

82. *Elaps fulvius* (Coral Snake) Montrose, Hoke Co., July 29, 1912, specimen killed and sent to State Museum by Dr. M. E. Street.

83. *Ancistrodon contortrix* (Copperhead). Wilmington, Lake Ellis, Raleigh, Chapel Hill, Jackson Co., Montreat. Not uncommon.

84. *Ancistrodon piscivorus* (Cottonmouth). Eastern Section. New Bern, Lake Ellis, Wilmington, Cape Hatteras, Washington, Beaufort, Whiteville, Raleigh.

85. *Crotalus adamanteus* (Diamond Rattlesnake). Jackson (Cope), Havelock (Craven Co.), and Pender Co. (J. A. Holmes), near the coast only.

86. *Crotalus horridus* (Banded Rattlesnake). Wilmington, New Bern, Dare Co., Lake Ellis, Beaufort, and in the mountains from Cherokee, Macon, Buncombe, Haywood, and Alexander counties.

*87. *Sistrurus miliarius* (Ground Rattlesnake). Wilmington, (Cope), Bogue and Shackleford's Banks (Coues 1871).

VI. TURTLES

88. *Terrapene carolina* (Box Tortoise, Highland Terrapin). Raleigh, Chapel Hill, Beaufort, Lake Ellis, Greensboro.

89. *Chelopus guttatus* (Speckled Terrapin). Raleigh, Beaufort, Lake Ellis, Southern Pines.

*90. *Chelopus muhlenbergi* (Muhlenberg's Terrapin). Three specimens taken October 1879, by A. L. Barringer at Statesville, (Yarrow in Check List).

91. *Malaclemmys centrata* (Diamond-back Terrapin). Salt marshes along the coast only. Beaufort, Brunswick, Carteret, Dare, New Hanover, Onslow, Pasquotank, Pamlico, Pender, Craven, and Hyde counties.

*92. *Deirochelys reticulata* (Chicken Turtle). "North Carolina to Florida inclusive" Ditmars in Reptile Book.

93. *Chrysemys picta* (Painted Terrapin). Raleigh, Chapel Hill, Greensboro, the most abundant turtle at the former place.

94. *Pseudemys concinna* (River Terrapin). Raleigh, and Tarboro, less common than in previous years at the former

place. Also two nearly hatched specimens, without data, in the Zoological Laboratory of University of North Carolina.

95. *Pseudemys floridana* (Florida Terrapin). Lake Ellis, also Richardson's Pond in Johnston Co.

96. *Pseudemys mobilensis* (Mobile Terrapin). A specimen 13 inches long in shell from White Lake, Bladen Co., doubtfully referred here.

*97. *Pseudemys rubriventris* (Red-bellied Terrapin). Specimens in U. S. National Museum from Kinston and Wilmington according to Yarrows Check List of North American Reptiles and Batrachians, 1883.

98. *Pseudemys scripta* (Yellow-bellied Terrapin). Raleigh and Lake Ellis, common, also recorded from Beaufort and Greensboro. Has apparently much increased in numbers at Raleigh of late years.

99. *Pseudemys troostii* (Troost's Terrapin). Raleigh, November 1914, one speciment 8 inches in shell.

100. *Cinosternum pennsylvanicum* (Mud Turtle). Tarboro, Raleigh, Chapel Hill, and Beaufort. Abundant.

101. *Aromochelys odoratus* (Musk Turtle). Raleigh, Lake Ellis, Greensboro. Less common and much more aquatic than the preceding.

102. *Chelydra serpentina* (Snapping Turtle). Raleigh, Chapel Hill, Lake Ellis, Beaufort.

*103. *Colpochelys kempi* (Kemp's Loggerhead, "Hawksbill"). Beaufort and Cape Hatteras.

104. *Thalassochelys caretta* (Loggerhead Sea Turtle), Beaufort and Pamlico Sound.

*105. *Chelone mydas* (Green Sea Turtle) Beaufort, rare.

106. *Dermochelys coriacea* (Leatherback Sea Turtle). Beaufort, May 27, 1897.

VII. CROCODILIANS

107. *Alligator mississippiensis* (Alligator). Brunswick, Craven, Carteret, Bladen, New Hanover, Onslow, and Robeson counties.

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RALEIGH, N. C.